

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

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| 1. | 课程名称 Course Title | 化学原理实验 General Chemistry Laboratory |
| 2. | 授课院系 Originating Department | 化学系 Department of Chemistry |
| 3. | 课程编号 Course Code | CH102-15 |
| 4. | 课程学分 Credit Value | 2 |
| 5. | 课程类别 Course Type | 专业基础课 Major Foundational Courses |
| 6. | 授课学期 Semester | 春季 Spring |
| 7. | 授课语言 Teaching Language | 中英双语 English & Chinese |
| 8. | 授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors) | <p>何绮婷, 化学系, 高级实验师 HE Qi-Ting, Department of Chemistry, Senior Experimentalist 理学院 College of Science, C3045 heqt@sustech.edu.cn</p> <p>李晓华, 化学系, 高级实验师 LI Xiao-Hua, Department of Chemistry, Senior Experimentalist 理学院 College of Science, C3048 lixh3@sustech.edu.cn</p> <p>汤小菊, 化学系, 高级实验师 TANG Xiao-Ju, Department of Chemistry, Senior Experimentalist 理学院 College of Science, C3045 tangxj@sustech.edu.cn</p> <p>颜瓊瑋, 化学系, 实验师 YAN Ai-Hui, Department of Chemistry, Experimentalist 理学院 College of Science, C3045 yanah@sustech.edu.cn</p> |

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|-----|---|---|-----------------------|------------------------|-------------------------------------|--------------|
| 9. | 实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact | 待公布 To be announced | | | | |
| 10. | 选课人数限额(可不填) Maximum Enrolment (Optional) | 最多 100 人, 每日最多 50 人。 Max. 100 students; 50 students/day. | | | | |
| 11. | 授课方式 Delivery Method | 讲授 Lectures | 习题/辅导/讨论 Tutorials | 实验/实习 Lab/Practical | 其它(请具体注明) Other (Please specify) | 总学时 Total |
| | 学时数 Credit Hours | 4 | 0 | 60 | 0 | 64 |
| 12. | 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements | 化学原理 / 大学化学 General Chemistry / Chemistry: The Central Science CH103 / CH105 | | | | |
| 13. | 后续课程、其它学习规划 Courses for which this course is a pre-requisite | 化学与探索 CH104 | | | | |
| 14. | 其它要求修读本课程的学系 Cross-listing Dept. | 非化学专业学生如果想学习化学实验的基本方法、基本操作与常见仪器, 也可选修本课程。 Non-chemistry major students who want to learn the basic methods, fundamental operations and common instruments of chemical experiments can also take this course. | | | | |

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程面向化学与非化学专业学生, 系统讲解化学实验的基本方法、基本操作与常见仪器, 涵盖化学实验的原理与应用。主要内容包括: 化学物质的提取/制备、分离/纯化、定性/定量分析, 仪器分析(可见分光光度计、阿贝折射仪), 数据处理与误差分析等。

This course is open to students who are/aren't majored in chemistry, it systematically introduces fundamental methods, basic operations and common instruments of chemical experiments, covering the principles and applications of chemical experiments. The main contents include: extraction/preparation, separation/purification, and qualitative/quantitative analysis of chemical substances, instrumental analysis (visible spectrophotometer, Abbe refractometer), data processing and error analysis, etc.

16. 预达学习成果 Learning Outcomes

了解化学实验的基本原理, 掌握基本操作, 熟悉常见仪器, 增强实验安全意识。学生将熟悉一系列无机化学实验、有机化学实验、分析化学实验与物理化学实验, 理实交融, 掌握解决实际生活中简单化学问题的基本方法。

After completing this course, students should master the basic methods, necessary skills, and instrument operation related to chemical experiments. They should be also familiar with laboratory safety rules. After learning a series of inorganic, organic, analytical and physical chemistry experiments, they should have a conceptual and practical understanding of a range of chemical principles, and master the basic methods for solving simple chemical problems in real life.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

SECTION 1 (WEEK 1)

4 学时/4 credit hours

绪论: 课程设置、实验内容、评分标准、化学科普、实验安全。

Introduction: course setting, experimental contents, grading rules, science popularization of chemistry, Lab safety.

SECTION 2 (WEEK 1)

实验室安全考核: 机考, 100 道单选或判断题, 每题 1 分, 总分 100 分。(化学系组织安排)

Lab safety test: computer-based, 100 multiple-choice or true/false questions, 1 point/question, and the full mark is 100 points. (Arranged by the Department of Chemistry)

SECTION 3 (WEEK 2-16)

60 学时/60 credit hours

实验一 化学平衡及其移动: 加深对有关电离平衡、氧化还原平衡、配位平衡及其移动理论的认识; 掌握缓冲溶液的配制和性质。(4 学时)

Experiment 1 Shifts in Chemical Equilibrium: To deepen the understanding of ionization equilibrium, redox equilibrium, coordination equilibrium and the theory of their shifts. To master the preparation method and the property of buffer solution. (4 credit hours)

实验二 粗盐的提纯: 学习粗盐提纯的原理和方法; 掌握溶解、沉淀、减压过滤、蒸发和分步结晶的基本操作; 学习对比和分类的方法。(4 学时)

Experiment 2 Purification of Crude Salt: To learn the principle and method of purification of crude salt. To master the basic operations of dissolution, precipitation, vacuum filtration, evaporation and fractional crystallization. To learn the methods of comparison and classification. (4 credit hours)

实验三 硫酸亚铁铵的制备及组成分析: 了解复盐的一般特性及硫酸亚铁铵的制备方法; 熟练掌握水浴加热、蒸发、结晶和减压过滤等基本操作; 学习用分光光度法定量检验产品中杂质 Fe^{3+} 的含量, 掌握标准曲线的绘制和应用。(5 学时)

Experiment 3 Synthesis of Ammonium Iron(II) Sulfate Hexahydrate: To understand the general characteristics of double salts and the preparation of ammonium iron(II) sulfate hexahydrate. To master the skills of water bath, evaporation, crystallization and vacuum filtration. To quantitatively determine the amount of Fe^{3+} impurity by spectroscopy, and master the plotting and application of standard curves. (5 credit hours)

实验四 硫酸纸的应用与纸茧的制作: 了解硫酸纸的主要成分、制作原理和应用领域; 分析硫酸纸膨胀变形的过程; 使用硫酸纸制作纸茧等结构模型作品。(3 学时)

Experiment 4 Application of Sulfuric Acid Paper and Preparation of Paper Cocoons: To understand the main components, production principles and application fields of sulfuric acid paper. To analyze the process of expansion deformation of sulfuric acid paper. To use the sulfuric acid paper to make paper cocoons and other structural model works. (3 credit hours)

实验五 酸碱标准溶液的配制与标定: 掌握标准溶液的配制方法; 学习滴定实验的原理, 熟悉滴定管、移液管的使用及滴定操作; 熟悉指示剂的使用和滴定终点的确定。(4 学时)

Experiment 5 Preparation and Calibration of Acid-Base Standard Solutions: To master the preparation method of standard solution. To learn the principle of titration experiment, be familiar with the use of burette and pipette and the operation of titration. Be familiar with the use of indicators and the determination of titration end points. (4 credit hours)

实验六 铁(III)-磺基水杨酸配合物的组成及其稳定常数的测定: 了解分光光度法测定配合物组成与稳定常数的原理和方法; 测定当 $\text{pH}<2.5$ 时, 磺基水杨酸合铁的组成及其稳定常数; 练习并掌握分光光度计的使用。(4 学时)

Experiment 6 Determination of Composition and Stability Constants of Iron (III)-Sulfosalicylic Acid Complexes: To understand the principle and method of stability constants of complexes by spectrophotometry. To determine the composition and stability constant of the sulfosalicylic acid and iron when $\text{pH}<2.5$. To master the use of the

spectrophotometer. (4 credit hours)

实验七 弱酸电离度和电离常数的测定: 学习溶液的配制方法及有关仪器的使用; 掌握弱酸电离度 α 与电离常数 K_a 的测定方法; 进一步熟悉滴定操作。(4 学时)

Experiment 7 Determination of Ionization Degree and Ionization Constant of a Weak Acid: To learn the preparation of solution and the use of relevant instruments. To grasp the method of measuring ionization degree α and ionization constant K_a of a weak acid. To get familiar with titration operation. (4 credit hours)

实验八 肥皂的制作与检验: 了解用植物油制作肥皂的方法; 掌握减压过滤的基本操作; 学习检验肥皂化学性质的方法。(4 学时)

Experiment 8 Preparation and Properties of Soap: To prepare soap in the laboratory starting with a vegetable oil. To master the experimental method of vacuum filtration. To learn how to examine the chemical properties of soap. (4 credit hours)

实验九 纳米银的制备及稳定性: 掌握还原法制备银纳米颗粒的方法; 用可见分光光度计表征胶体银, 研究光谱吸收峰位置与颗粒大小的关系; 了解胶体银的介稳性和聚沉效应。(4 学时)

Experiment 9 Synthesis and Study of Silver Nanoparticles: To synthesize the silver nanoparticles by reduction. To characterize the colloidal silver with visible spectrometer and study the relationship between spectral absorption peak position and particle size. To understand the stability and aggregation of colloidal silver. (4 credit hours)

实验十 化学反应速率与活化能的测定: 了解浓度、温度和催化剂对化学反应速度的影响; 测定 $(\text{NH}_4)_2\text{S}_2\text{O}_8$ 与 KI 反应的速率、反应级数、速率系数和反应活化能。(4 学时)

Experiment 10 Determination of Chemical Reaction Rate and Activation Energy: To understand the influences of concentration, temperature and the catalyst on the reaction rate. To determine the reaction rate, reaction series, rate coefficient and the reaction activation energy of $(\text{NH}_4)_2\text{S}_2\text{O}_8$ and KI. (4 credit hours)

实验十一 旋光法测定蔗糖水解反应的速率常数: 学习旋光仪的基本原理和使用方法; 了解反应物浓度与旋光度之间的关系; 测定蔗糖在酸催化条件下的水解反应速率常数和半衰期。(4 学时)

Experiment 11 Rate constant for the Conversion of Sucrose by a Polarimetric Method: To learn the basic principle and the correct use of a polarimeter; To know the relationship between the reactant concentration and optical rotation; To determine the rate constant and the half-life for the conversion of sucrose. (4 credit hours)

实验十二 薄层层析与柱层析: 了解偶氮苯的光学异构化反应; 掌握薄层层析 (TLC) 的原理; 通过薄层层析分离顺式和反式偶氮苯并计算其 R_f 值; 学习柱层析 (CC) 分离有机化合物的原理; 掌握层析柱装填和洗脱的操作方法; 通过柱层析分离甲基橙与亚甲基蓝。(4 学时)

Experiment 12 Thin-Layer Chromatography and Column Chromatography: To understand the optical isomerization of azobenzene. To master the principle of thin-layer chromatography (TLC). To separate *cis*- and *trans*-azobenzene by TLC and calculate their R_f 's. To learn the principle of separation of organic compounds by column chromatography (CC). To master the method of packing and elution of the column. To separate methyl orange and methylene blue by CC. (4 credit hours)

实验十三 分离酸性、碱性和中性有机化合物: 通过检验每次萃取中有机相中的成分, 理解萃取法和可视化分离多达四组分混合物的过程。(4 学时)

Experiment 13 Separation of Acidic, Basic and Neutral Organic Compounds: To understand the chemical basis of separation of up to a four-component mixture using extraction techniques and visualizing the separation by checking the composition of the organic layer after each extraction. (4 credit hours)

实验十四 茶叶中提取咖啡因: 了解天然有机化合物提取的方法; 学习脂肪提取器的使用; 掌握升华提纯固体有机物的原理及操作方法; 掌握显微熔点仪的使用方法。(4 学时)

Experiment 14 Soxhlet Extraction of Caffeine from Tea Leaves: To learn the natural compound extraction. To master the operation of Soxhlet extraction. To master the principle and operation of purification of solid organic compounds by sublimation. To master the operation of melting point microscope. (4 credit hours)

实验十五 乙酸乙酯的制备: 掌握由乙酸和乙醇制备乙酸乙酯的酯化原理和方法; 掌握液体有机化合物的纯化方法, 熟悉蒸馏、分离、干燥等操作; 掌握阿贝折光仪的原理及使用方法。(4 学时)

Experiment 15 Preparation of Ethyl Acetate: To master the esterification principle and method for preparing ethyl acetate from acetic acid and ethanol. To know the purification of organic liquids, and master basic operations such as distillation, separation and drying. To learn the principle and operation of an Abbé refractometer. (4 credit hours)

18. 教材及其它参考资料 Textbook and Supplementary Readings

指定教材：《化学原理实验》，南方科技大学，化学教学实验室主编。

Students' Book: General Chemistry Laboratory, SUSTech, edited by Chemistry Experiment Teaching Center.

推荐参考资料：《普通化学实验》，同济大学化学系，杨勇主编，同济大学出版社。

课程评估 ASSESSMENT

| 19. 评估形式 Type of Assessment | 评估时间 Time | 占考试总成绩百分比 % of final score | 违纪处罚 Penalty | 备注 Notes |
|-----------------------------------|--------------|----------------------------------|-----------------|--|
| 出勤 Attendance | | 5 | | 病假须有医院的有效病假条，事假须提供生活导师签字的请假条。学生必须在实验开始前向指导教师说明。统一时间补做实验。 A valid sick leave must be issued by the hospital. A leave of absence is required and signed by the student's life tutor. The student must explain to the instructor before the experiment begins. The lab will arrange a unified time for the students to complete the experiments. |
| 课堂表现 Class Performance | | 40 | | |
| 小测验 Quiz | | 10 | | |
| 课程项目 Projects | | | | |
| 平时作业 Assignments | | 45 | | 预习报告 10 分，实验报告 35 分。 Preview report 10', Experimental report 35'. |
| 期中考试 Mid-Term Test | | | | |
| 期末考试 Final Exam | | | | |
| 期末报告 Final Presentation | | | | |
| 其它 Others | | | | |

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading
 B. 二级记分制（通过/不通过） Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

化学系课程规划与审核委员会
Curriculum Planning and Review Committee, Department of Chemistry